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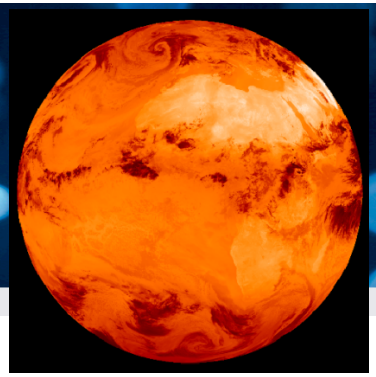
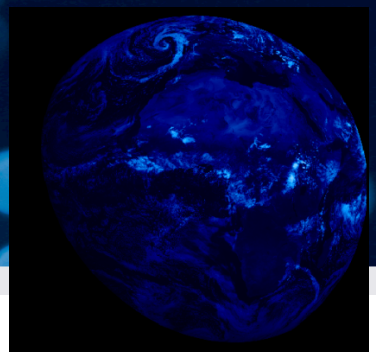
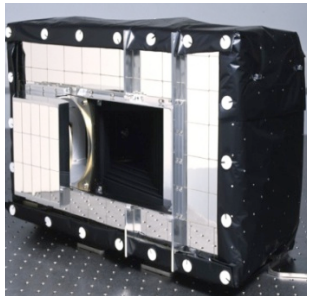
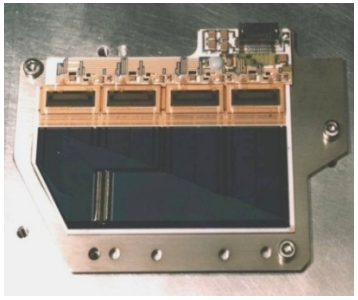


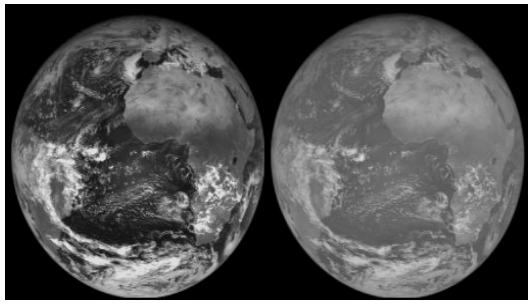


GERB 2-1 X-Cal & GERB 2-1-3 X-Calibration Plans

Rich Bantges







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Contents

- Overview of GERB 2-1 X-CAL studies and updates since the GERB 2-1 X-CAL
- Plans for the GERB 2-1-3 X-CAL

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GERB 2-1 X-CAL

GERB 2-1 X-CALIBRATION AIMS

- Supplement / enhance individual validation exercises undertaken for each instrument
- Investigate differences between GERB 1 & GERB 2, focussing on relative calibration not absolute accuracy
- Provide information to enable a single data record on a common scale (required for climate studies) → focussing on highest level products.

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GERB 2-1 X-CAL

Overlap data periods

Dates	GERB-1 (MSG-2) longitude (˚E)	GERB-2 (MSG-1) longitude (˚E)	CERES PAPS scan time and location
24/04/06 –04/07/06 (01/06/06 - 30/06/06)	-6.65 to -6.35	-3.55 to -3.25	01/06/06 – 30/06/06 6.5 W (S Hemi)
19/07/06 – 17/08/06	+0.5 to +0.25	-3.55 to -3.45	N/A
09/01/07 – 10/02/07	+0.0 to +0.8	-3.6 to -3.45	19/01/07 – 10/02/07 1.75 W (N Hemi)
19/04/07 – 30/04/07	-0.4	-3.55	N/A
01/05/07 – 10/05/07	-0.4	-3.55	N/A

Data available latest version (reprocessed & corrected)

Data available for original processing only

Data unavailable

GERB 2-1 X-CAL

L2 BARG LW Flux: Daily mean

GERB 1 > GERB 2

	GERB 1 LW Flux		GERB 2 LW Flux		100%x(G2-G1/G2)
	Mean (Wm^{-2})	Std. dev. (Wm^{-2})	Mean (Wm^{-2})	Std. dev. (Wm^{-2})	
Jan 2007	251.71	5.72	250.86	5.38	-0.34
Feb 2007	247.65	5.75	246.66	5.37	-0.40
May 2007	252.73	5.44	251.63	5.47	-0.44

Table 3.1.1: Daily mean flux calculated for January, February and May 2007. An area (60N/S, 60E/W) mean value was calculated for each 15 minute data interval for all days within the month where data existed for both GERB 1 and GERB 2. A monthly mean value for each 15 minute time interval was then computed, and finally a mean daily flux, and its associated standard deviation, was calculated from the 96 (15 minute) time intervals. The standard deviation is indicative of the mean 15 minute flux variability through the day.

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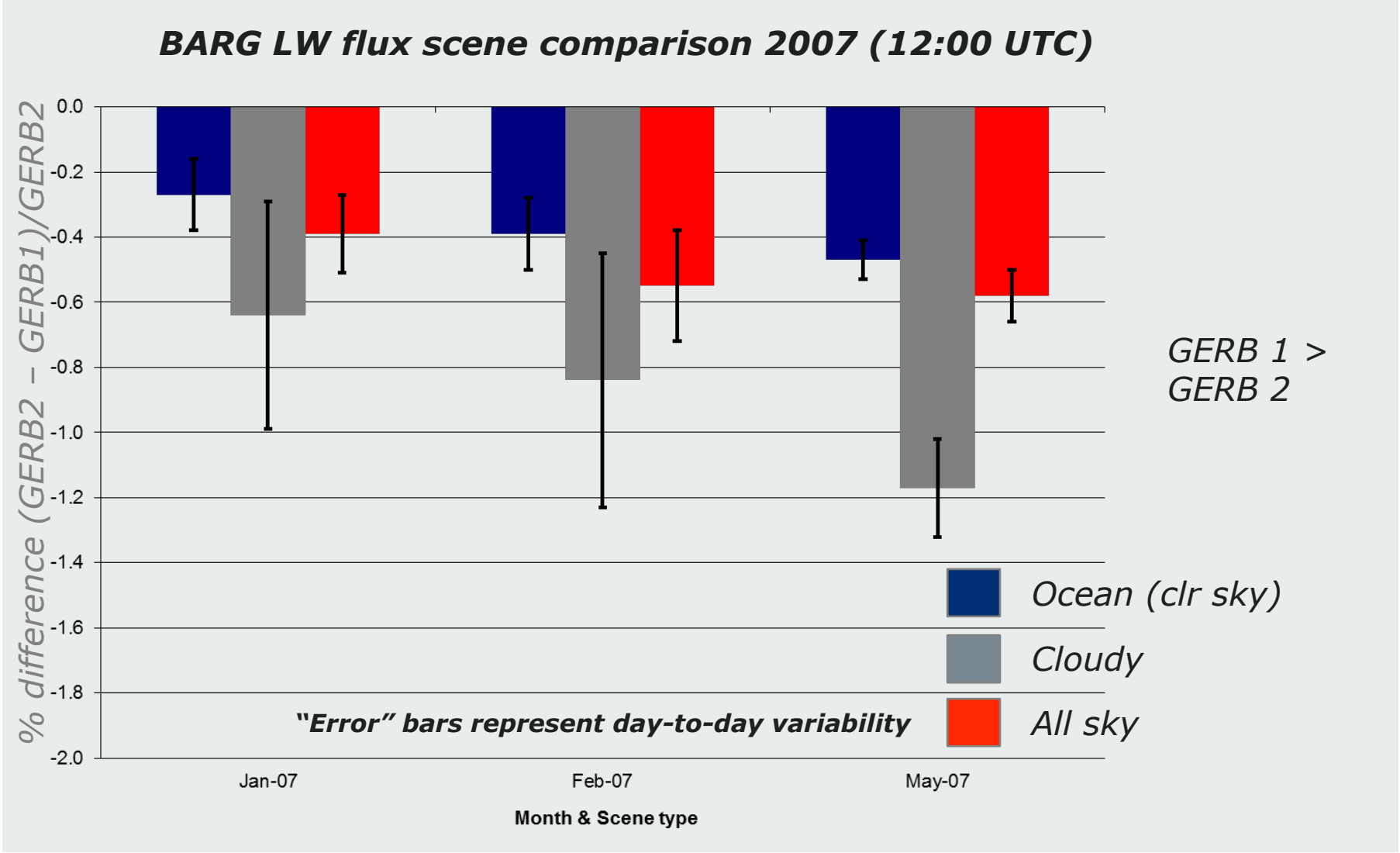
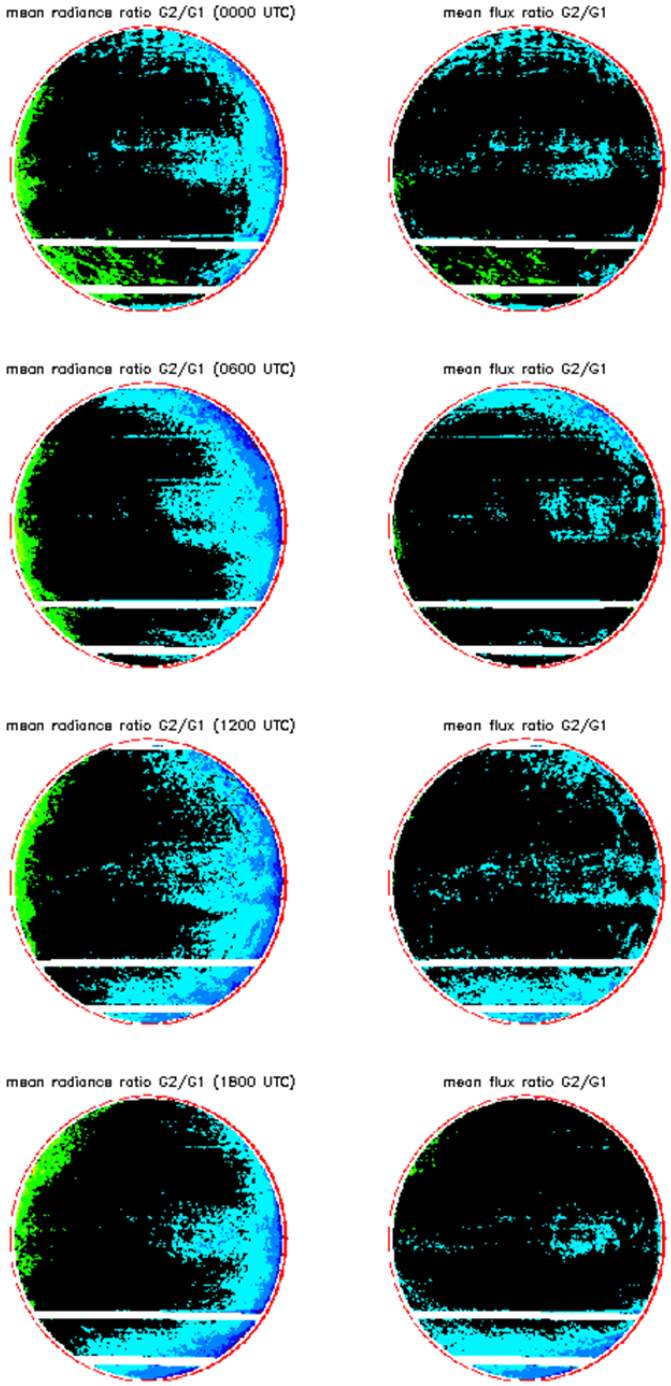
GERB 2-1 X-CAL

L2 BARG LW Flux: Scene comparisons



GERB 2-1 X-CAL

L2 BARG LW Flux: Spatial comparison (6-hourly intervals)



00:00 UTC

06:00 UTC

12:00 UTC

18:00 UTC

- *Radiance: east / west variation*
- *Flux: east / west largely removed*

-> angular distribution models ok

- *Flux residuals could be indication of spectral response differences for coldest scenes*

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GERB 2-1 X-CAL
L2 BARG LW Summary

- On average, GERB 1 LW flux data are approximately 0.4±0.04% higher than GERB 2
- A diurnal variation in this offset of ±0.3% is observed (min^m and max^m time varies with month)
- A scene dependence in the difference is observed:
  - »Coldest scenes 0.9±0.3% GERB1 > GERB2
  - »Clear ocean scenes 0.38±0.09% GERB1>GERB2
- Comparisons with CERES (flux SSF Ed2 Rev1):
  - GERB < CERES ~1%

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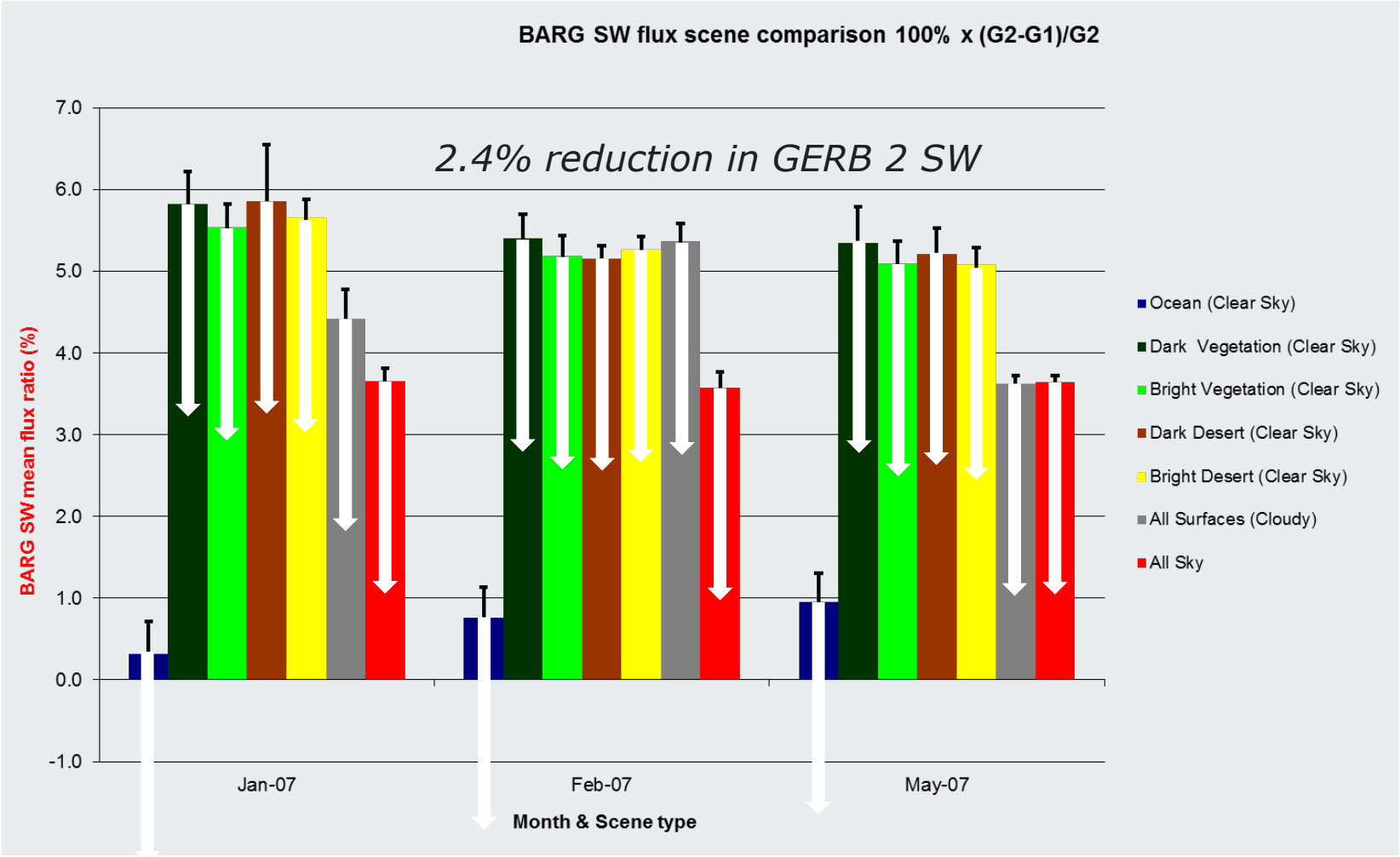
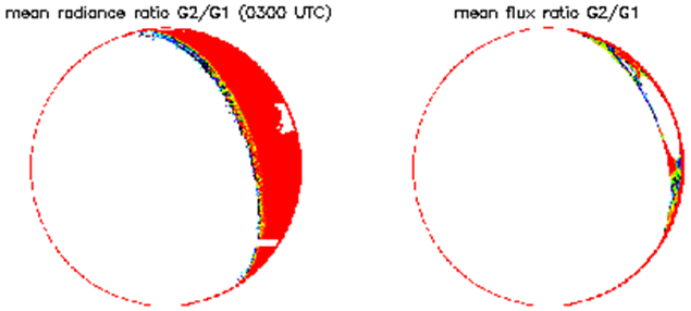
GERB 2-1 X-CAL

L2 BARG SW Flux: Scene Comparison



GERB 2-1 X-CAL

L2 BARG SW Flux: Spatial comparison (3-hourly intervals)



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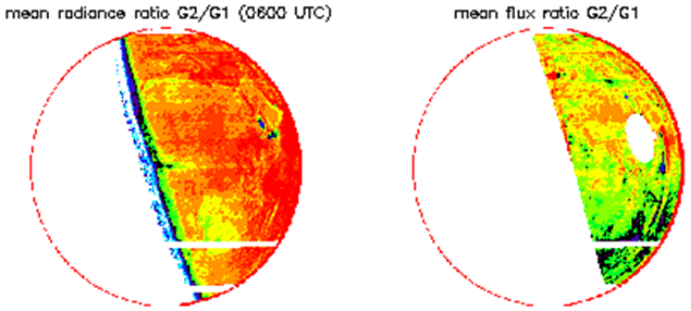

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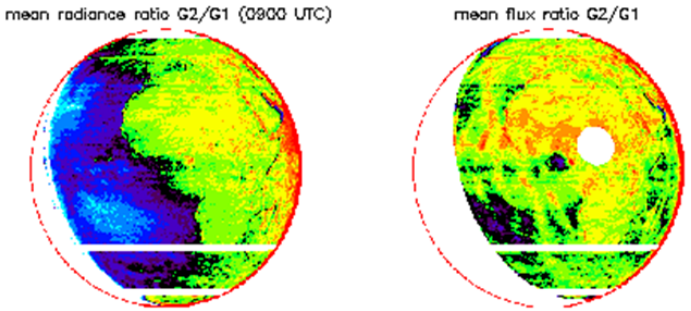
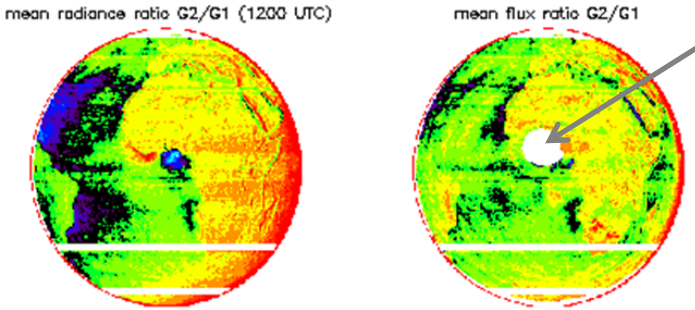


09:00 UTC

Sun glint



12:00 UTC

- *Radiances – east / west variation*
- *Fluxes – east west variation removed, offset remains*
- *Clearly, scene dependent offset remains*

SWupdate

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GERB 2-1 X-CAL
L2 BARG SW Flux Summary

- All sky results indicate gross offset in SW BARG fluxes: GERB 1 is on average 1.5±0.3% < GERB 2
- Significant scene dependency observed:
  - **Clear land: 3.0 ± 0.4% GERB 1 < GERB 2**
  - **Clear ocean: -1.6. ± 0.3% GERB 1 < GERB 2**
  - **Overcast: 1.2 to 3.0% GERB 1 < GERB 2**
- Independent validation studies suggest GERB 2 spectral response altered during lifetime and in 2007 was on average 1.8 (flux) lower than in 2004.
- Comparisons with CERES (flux SSF Ed2 Rev1):
  - GERB2 > CERES 3-5%
  - GERB1 > CERES 0-2%

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GERB 2-1 X-CAL
Conclusions & Recommendations

- Users of GERB data were made aware that the swap from G2->G1 on 1st May 2007, results in a jump in the LW and SW flux records.
- At present, users should allow for ~0.4% increase to the GERB LW flux, and ~ 1.5% (after Swupdate to GERB2) reduction in the SW, but be aware of scene dependency.
- These jumps remain in Edition 1 record, but Edition 2 will address these issues.

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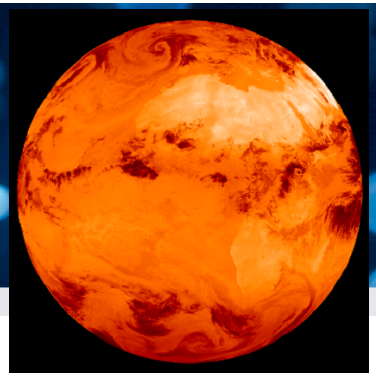
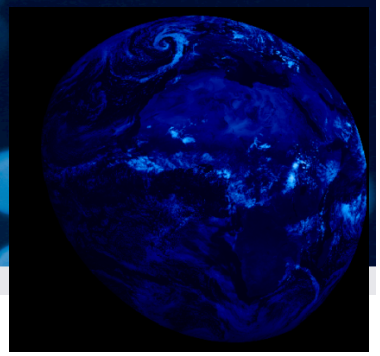
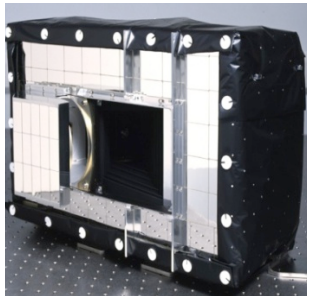
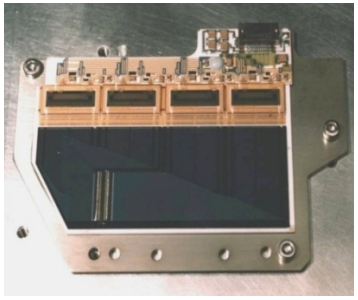
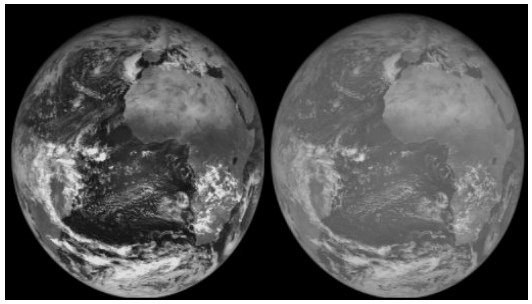




GERB 2-1-3
Inter-calibration Plans







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GERB 2-1-3 X-CAL PLANS

AIMS

- Supplement / enhance individual validation exercises undertaken for each instrument
- Investigate differences between GERB 2,1 & GERB 3, focussing on relative calibration not absolute accuracy
- Provide information to enable a single data record on a common scale (required for climate studies) → focussing on highest level products.
- **Additional measurements during re-calibration for GERB-3 shown potential inconsistencies (studies to tease out differences)**

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GERB 2-1-3 X-CAL PLANS
MSG manoeuvres

SEVIRI: 1st November to January : Plan to operate GERBs 1, 2 & 3 in NORMAL
(until Jan 8th GERB 3, Jan 10th GERB 1, Jan 24th GERB 2)

FES imaging from SEV3 (MET-10 cal/val at 3.4°W)
(occasional interruptions and decon. outage 3-7th December)
FES imaging from SEV2 (MET-9 operational at 0°)
FES imaging from SEV1 (MET-8 RSS at 9.5° E) 13-15 Nov; 11-13 Dec; 8th Jan–7th Feb

GERB

Satellite	Drift	Dates	GERB mode
MET-10 (MSG3)	3.4°W to 0°	8th Jan to 15th Jan	SAFE
MET-9 (MSG2)	0° to 9.5°E	10th Jan to 29th Jan	SAFE
MET-8 (MSG1)	9.5°E to 3.5°E	24th Jan to 5th Feb	SAFE

GERB 3 (MET-10) in NORMAL from 15th Jan onwards
GERB 1 (MET-9) in NORMAL from 29th Jan onwards

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GERB 2-1-3 X-CAL PLANS

GERB overlaps and locations

GERB 2 (MET-8)	GERB 1 (MET-9) currently operational	GERB 3 (MET-10) Prime from 14-Jan-12
9.5°W 1st Nov – 8th Jan (SEVIRI FES 12-15th Nov & 11-13 Dec ?)	**0° 1st Nov – 9th Jan** (SEVIRI in FES)	**3.4°W 1st Nov – 7th Jan** (SEVIRI in FES except 3-7th Dec)
9.5°W 9th Jan – 23rd Jan (SEVIRI FES?)	**9.5°E 30th Jan – 12th Feb** (SEVIRI in FES)	**0° 16th Jan –** (SEVIRI in FES)
3.5°E 5th Feb (SEVIRI FES?)		

X-CAL DATA

November 1st to Dec 3rd

GERB 1 (0°) & GERB 3 (3.4° W) with SEV FES
GERB 2 (9.5° W) 12-15th Nov with SEV FES

Dec 7th to Jan 7th

GERB 1 (0°) & GERB 3 (3.4° W) with SEV FES
GERB 2 (9.5° W) 11-13th Dec with SEV FES

Jan 30th to Feb 12th

GERB 1 (9.5°E) & GERB 3 (0°) with SEV FES

3 instrument lunar cals: 1st during SEVIRI decontamination Dec 2012

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GERB 2-1-3 X-CAL PLANS

Intended studies

- BARG LW & SW Flux comparisons (scene, spatial)
  - GERB 2-1 (check for changes since last x-cal 2006/7)
  - GERB 2-1-3
- Investigation of pixel variability:
  - GERB 2-1-3 L1.5 NANRG (filtered) vs CERES unfiltered radiances (angular matched) -> unfiltering curve variability
- Lunar (L0) studies
- Comparisons with CERES (radiances & fluxes)
  - Jan & Dec 2004
  - Jan -> Feb 2007
  - Dec 2012 / Jan 2013 (tbc)

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GERB 2-1-3 X-CAL PLANS

X-CAL Timeline

- Studies begin Q1 2013
- Initial findings reported to GIST 33
- Final report due Q3 2014

- Comments and suggestions for studies welcome

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EXTRAS

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GERB 2-1 X-CAL

LW GERB 2,1 vs CERES SSF Ed2 Rev1

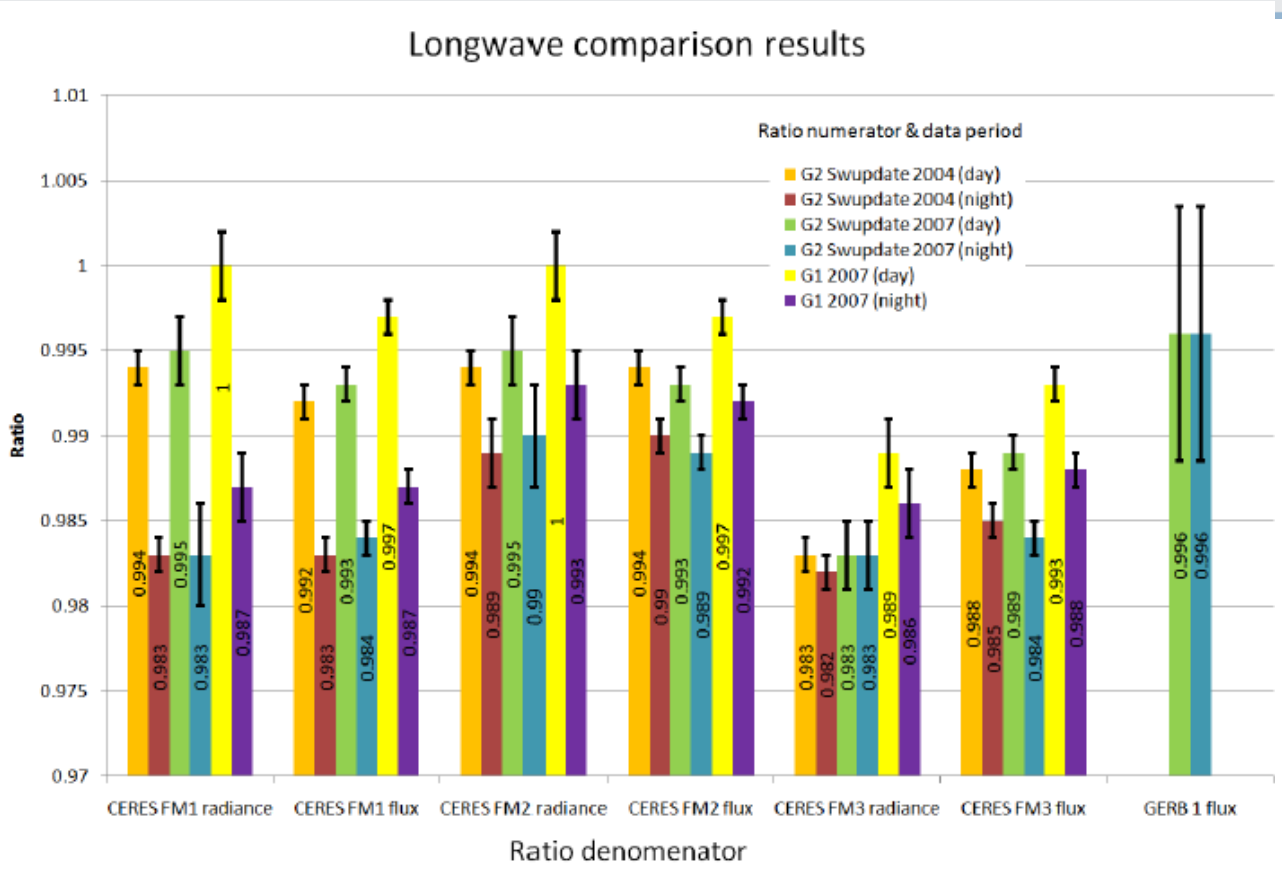

Figure 2. Summary of comparison results average longwaye ratios shown, data used denominator and whether flux or radiance is compares is shown on the x-axis, data used in the numerator and the time period of the comparison is indicated in the legend. Ratios are calculated from the mean of matched points each day, the mean ratio is then determined over the whole period and its associated standard deviation calculated. Error bars show the 3σ uncertainty based on the variability in the individual ratios calculated. All GERB 2 data have the SW calibration update applied, results shown for GERB 2 for June and December 2004 are taken from Clerbaux et al. 2008 and adjusted to account for the GERB 2 SW calibration update.

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GERB 2-1 X-CAL

SW GERB 2,1 vs CERES SSF Ed2 Rev1

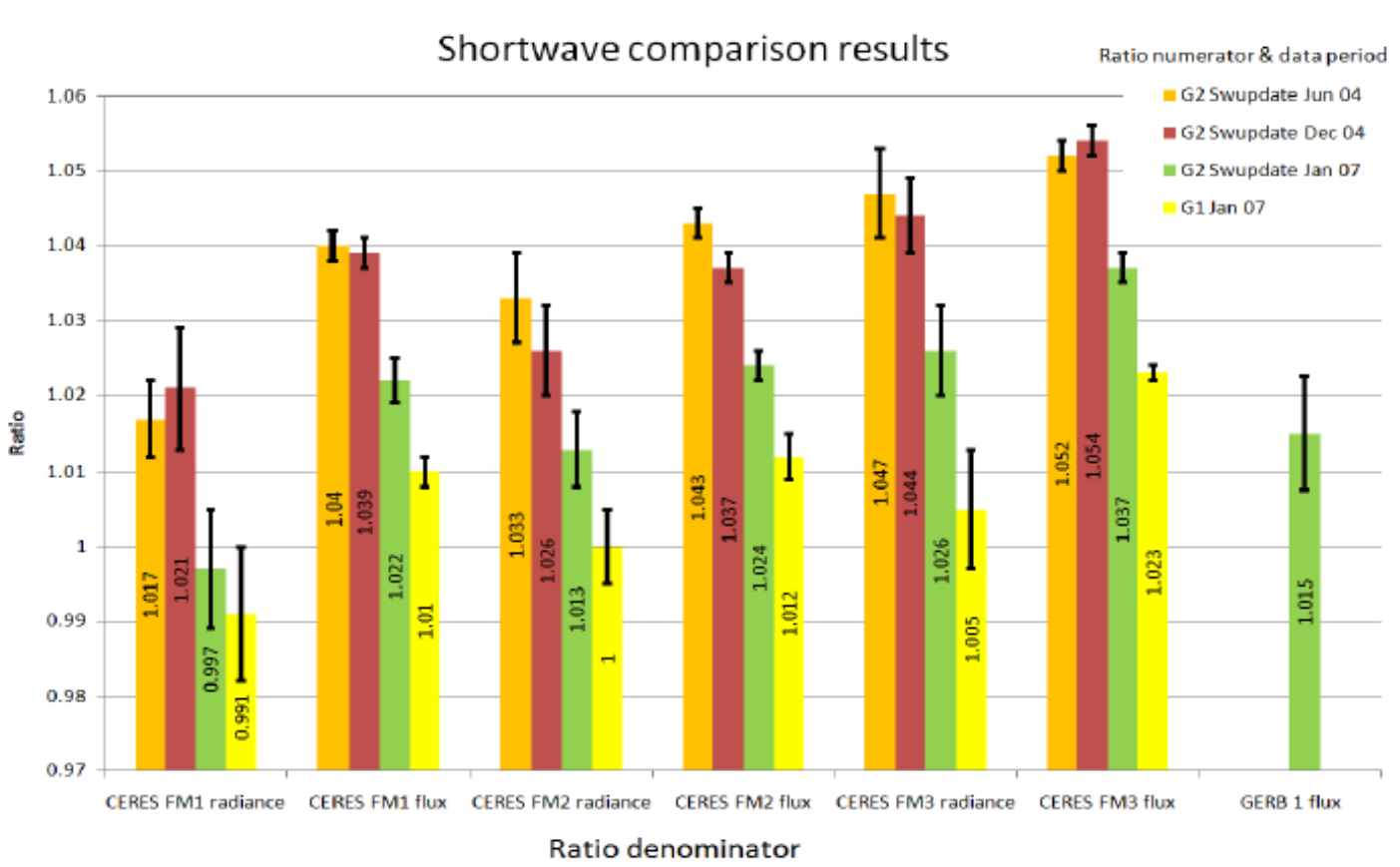

Figure 1. Summary of comparison results average shortwave ratios shown, data used denominator and whether flux or radiance is compares is shown on the x-axis, data used in the numerator and the time period of the comparison is indicated in the legend. Ratios are calculated from the mean of matched points each day, the mean ratio is then determined over the whole period and its associated standard deviation calculated. Error bars show the 3σ uncertainty based on the variability in the individual ratios calculated. All GERB 2 data have the SW calibration update applied, results shown for GERB 2 for June and December 2004 are taken from Clerbaux et al. 2008 and adjusted to account for the GERB 2 SW calibration update.

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GERB 2-1-3 X-CAL PLANS

GERB 3 calibration parameters

- Baseline calibration parameters have been issued
  - B (SW / TOT channel gain ratio),
  - T (quartz filter transmission)
  - SW and TOT channel spectral response.
  - This first issue follows the same procedure as for previous GERB instruments and for consistency will be used to make a first run processing of the commissioning data.
- However ground calibration of GERB 3 was more extensive and provides additional information on system level spectral response which is being used to determine an issue 2 for a second processing. Our current minimum expectation is to update calibration parameters for pixel 2:50 (Northern-most pixels on the Earth)

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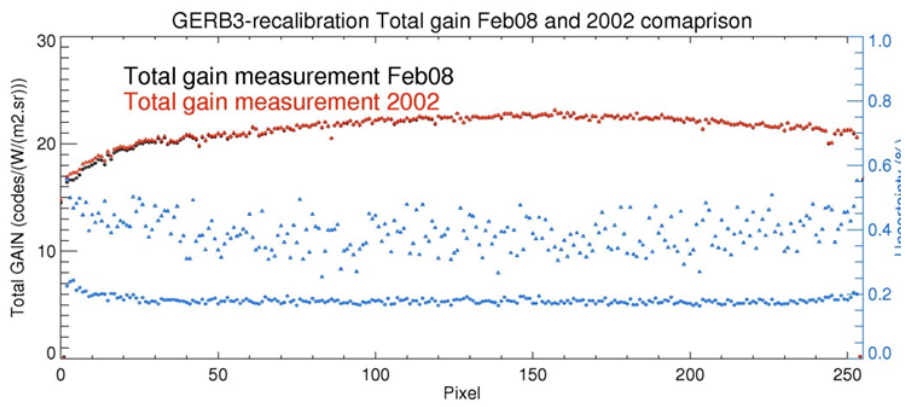
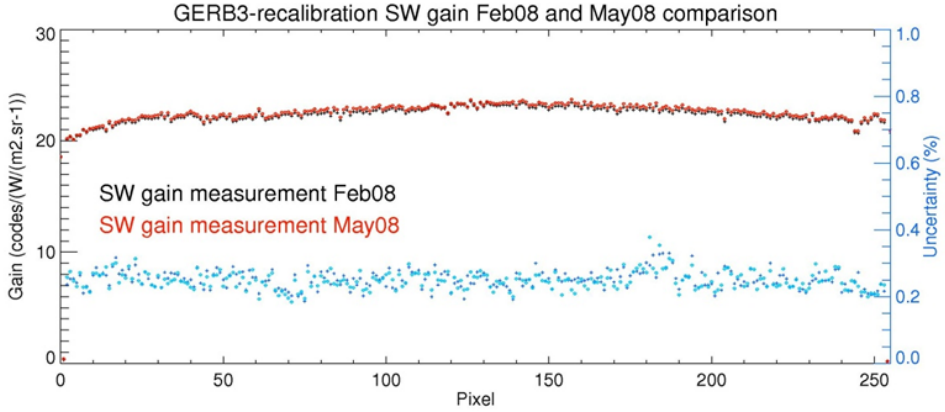
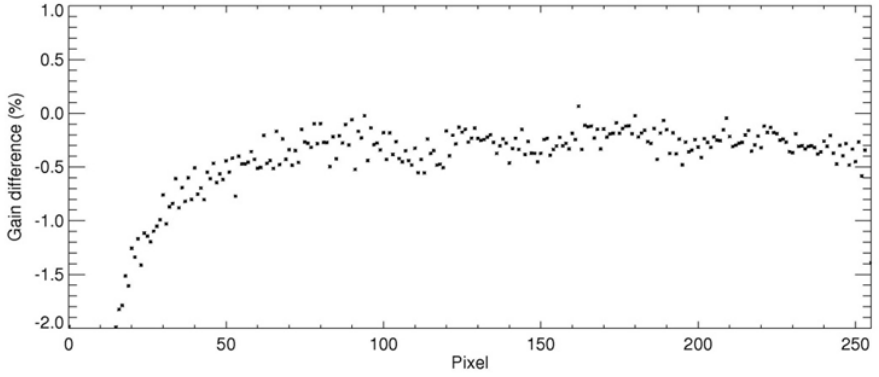
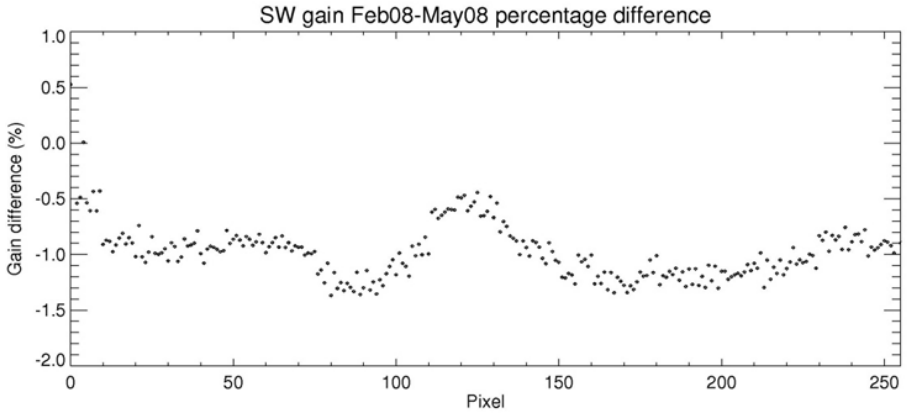
GERB 2-1-3 X-CAL PLANS

GERB 3 calibration parameters: Ground calibration2002 to 2008 change









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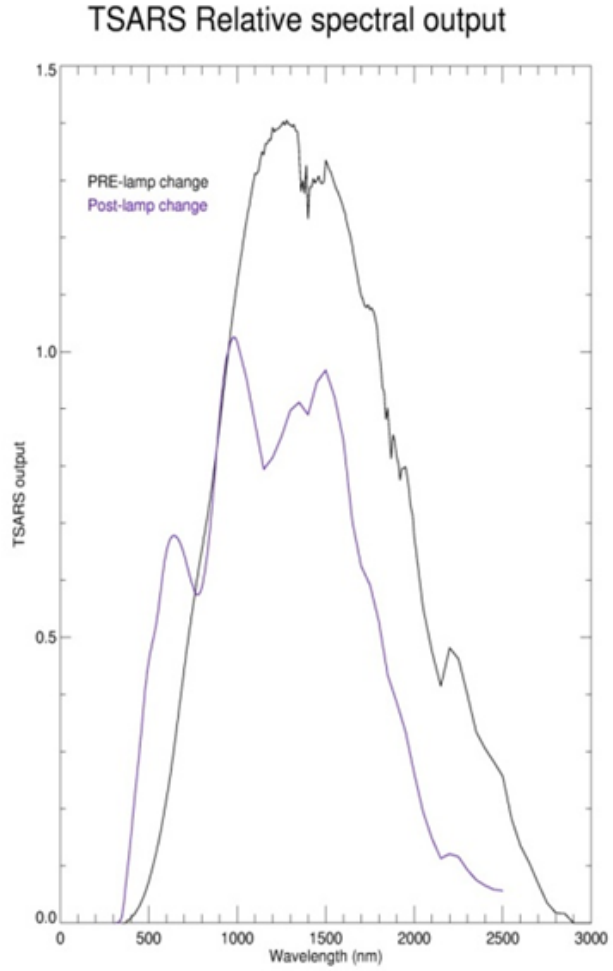
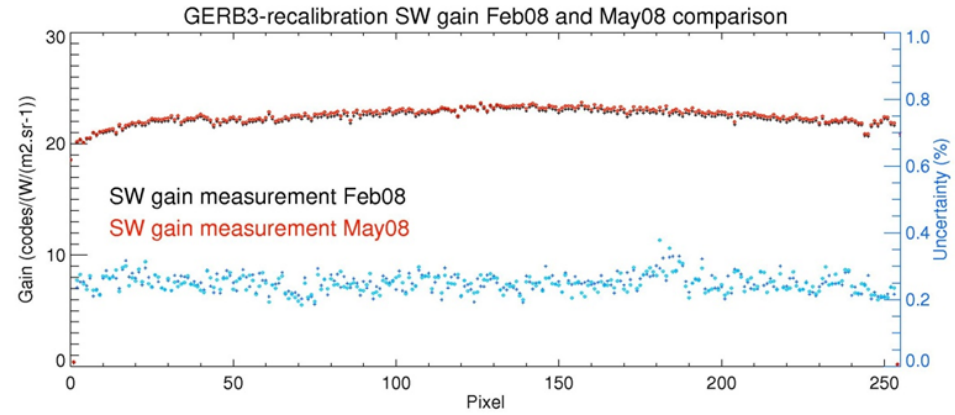
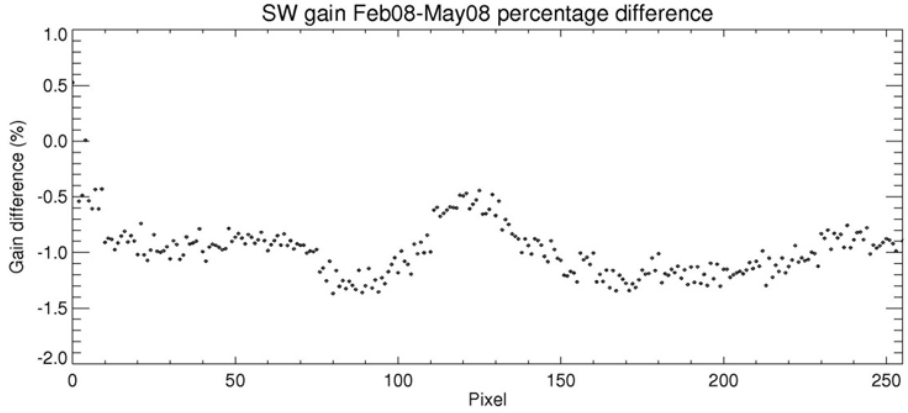
GERB 2-1-3 X-CAL PLANS

GERB 3 calibration parameters: Ground calibration2002 to 2008 change







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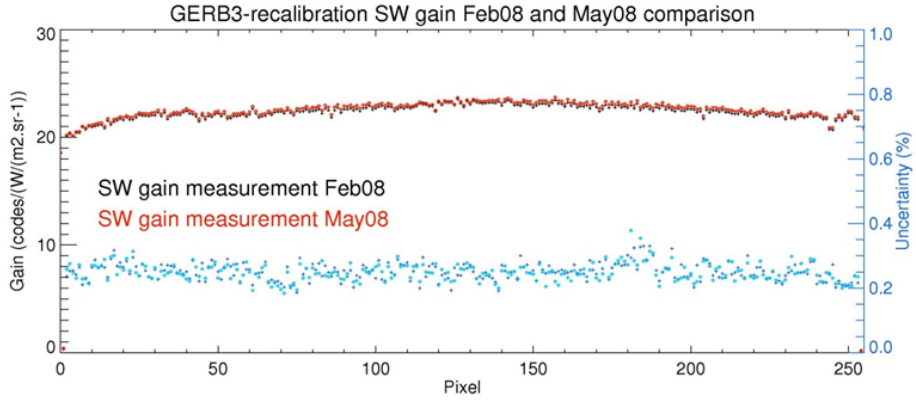
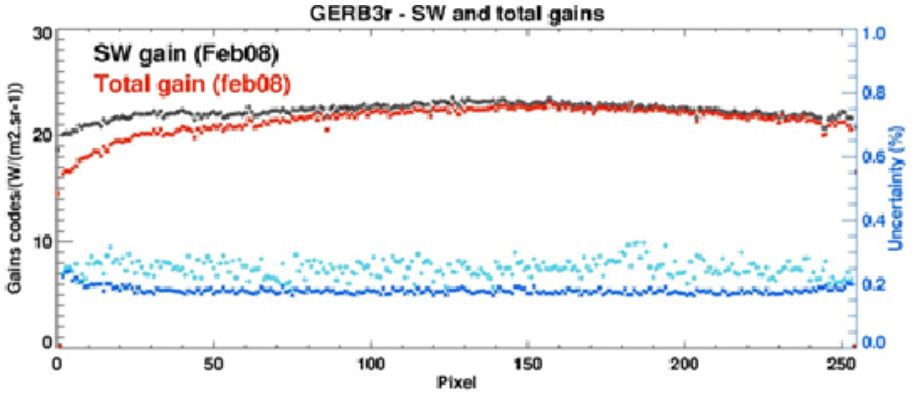
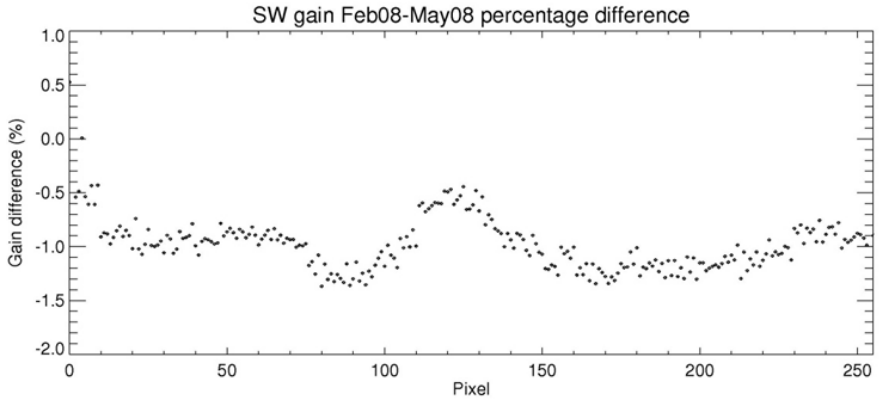
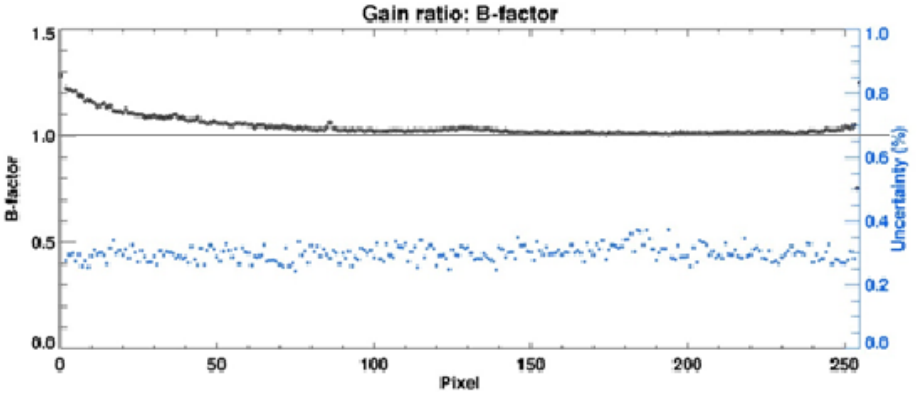
GERB 2-1-3 X-CAL PLANS

GERB 3 calibration parameters: SW gain / TOTAL gain ratio









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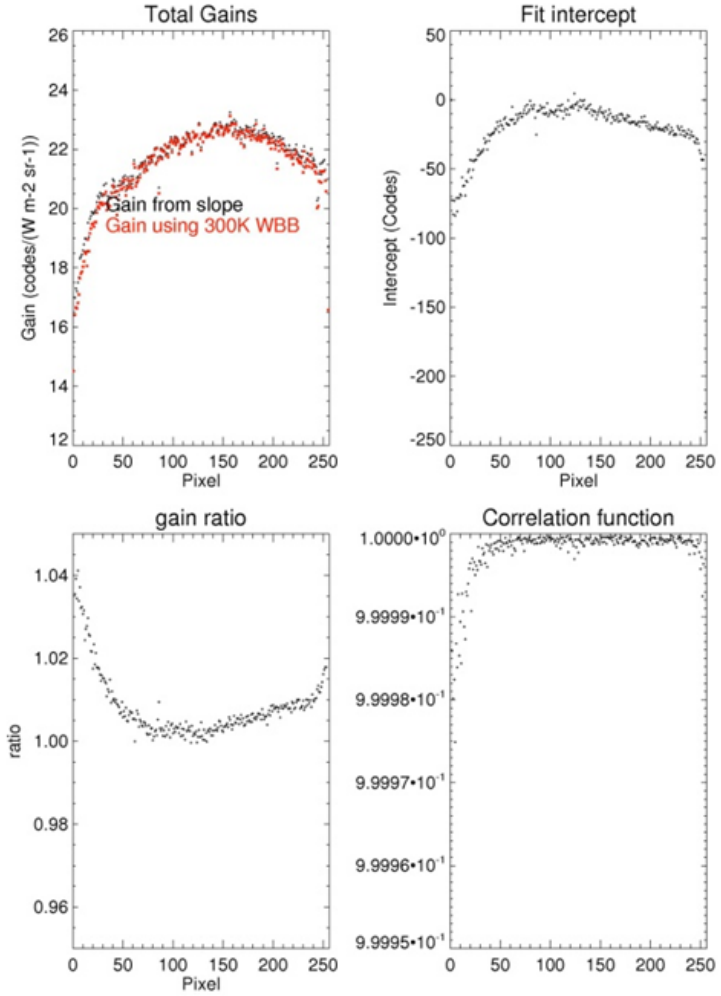
GERB 3 calibration parameters



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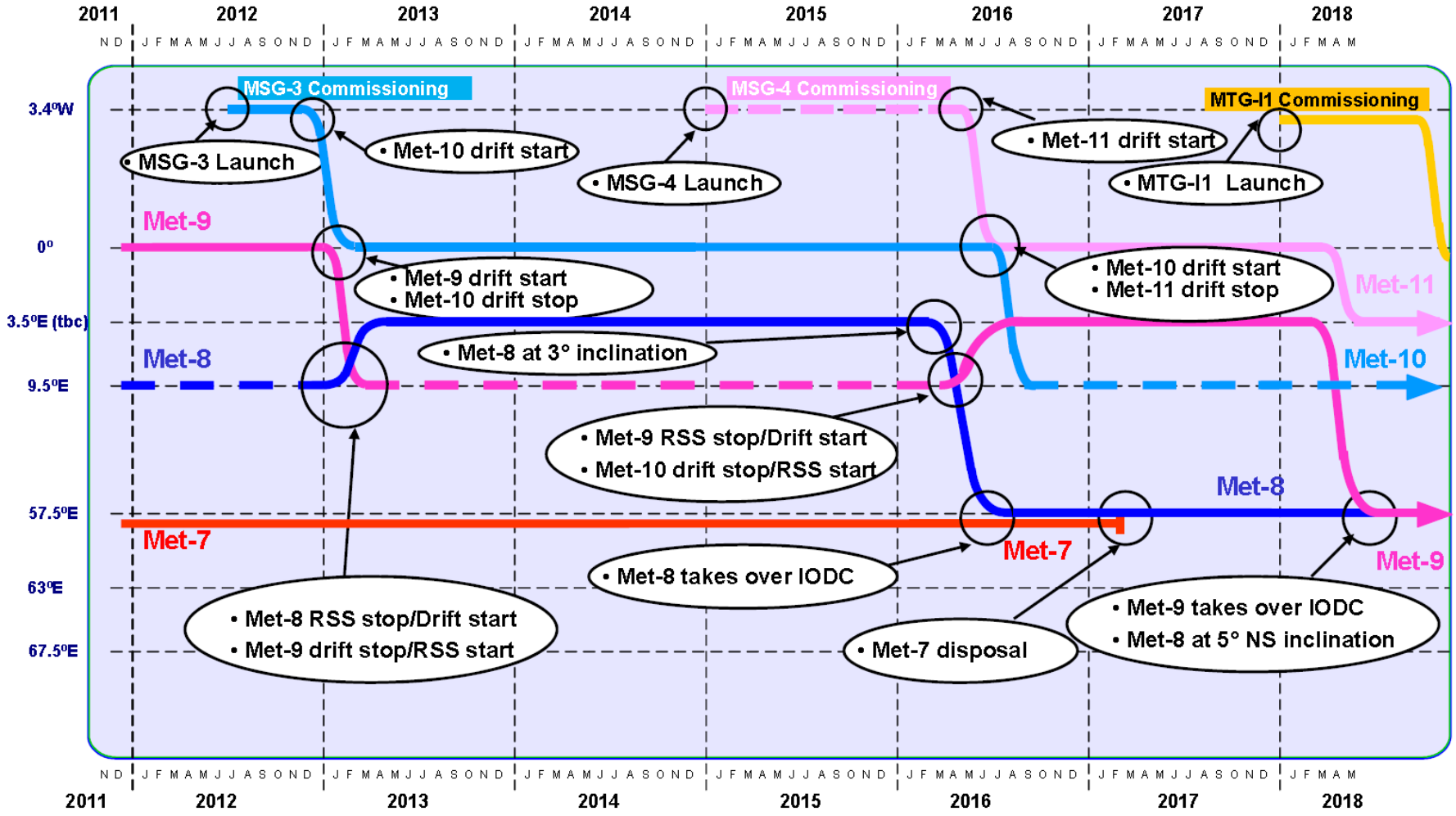
GERB 2-1-3 X-CAL PLANS

Geostationary Satellite Status

Meteosat Long-Term Planning Perspective



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GERB 2-1-3 X-CAL PLANS

Geostationary Satellite Status

- MET-9 (MSG-2 / GERB-1) Current prime operational satellite in geo orbit at 0º. SEVIRI fulfilling the Full Disc Scanning Service (FDSS), GERB current operational record.

- MET-8 (MSG-1 / GERB-2) at 9.5ºE. SEVIRI is fulfilling the Rapid Scanning Service (RSS), occasional calibration and special activation of GERB

- MET-7 (MTP) at 57ºE is fulfilling the Indian Ocean Data Coverage (IODC) service.

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Geostationary Earth Radiation Budget project

- The Edition 1 record for GERB on METEOSAT-8 (April 2004-May 2007) and GERB on METEOSAT-9 (May 2007 – Dec 2010) is available from the BADC
- These first edition data are based on the instrument ground calibration no instrument inter-calibration or in obit calibration changes are applied.
- A fill field for the BARG product to include best estimates of missing values in sun-glint and twilight conditions(SZA 80 -100°) are being developed for release later this year
- Example monthly average comparison incorporating the fill data submitted the GEWEX radiation flux assessment
- There has been an apparent reduction of between 1.5-2% overall in the GERB 2 SW between 2004 and 2007, changes for ocean are larger at around 4% in terms of GERB/CERES inter-calibration change & from GERB 1 GERB 2 scene differences.

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GERB 2-1 X-CAL
GERB Data Products

- Level 2 Products:
  - **B**inned **A**veraged **R**ectified **G**eolocated (BARG)
    "Climate" product - unfiltered SW&LW radiance and flux
    Regular grid (VZA)
    PSF removed - 45km resolution (at nadir)
    15 minute resolution
  - **A**veraged **R**ectified **G**eolocated (ARG)
    Unfiltered SW&LW radiance and flux
    Regular grid (VZA)
    PSF not removed
    16.92 minute resolution (3 scan average)
- Level 1.5 Products:
  - **N**on **A**veraged **N**on **R**ectified **G**eolocated (NANRG)
    Filtered SW&TOTAL radiance
    Single image: TOT (0.3-500μm), SW (0.3-4.0μm)
    Image acquired ~3 minutes
- Level 0 Data (Non release data)
  - Raw data

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GERB 2-1 X-CAL
Updates: Calibration & Processing

- Calibration:
  - Quartz filter transmission for GERB 1 reduced by 1%
- Processing:
  - Inconsistency between cloud retrieval lookup tables for GERB1 -> incorrect scene ID -> incorrect radiance to flux conversion
  - Offline reprocessing of overlap data performed
  - Error in clear-sky reference image
- “Reprocessed & Corr.” GERB 1 data produced
- GERB 2 data remained unchanged

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GERB 2-1 X-CAL
Conclusions & Recommendations (2)

- Users will be advised to apply the following multiplication factors, for gross adjustment:
  - GERB 1 LW Flux by 0.996
  - GERB 1 SW Flux by 1.05 (all scenes except ocean)
- Users should note that new (current) knowledge suggests GERB 2 SW will be lowered by 2.5 to 3.5% in future Editions.
- Some evidence for spectrally dependent darkening throughout lifetime of GERB 2 optics for bluest scenes. Investigations on-going.
- Full x-cal document: MSG-ICL-GE-RP-0036